DME Component Libraries

industry-proven algorithms available in native Java and .NET development libraries

These flexible programming libraries are designed for users needing to rapidly develop enterprise-ready solutions or add industry-leading systems modeling capabilities to their existing applications . Modeled from the foundational elements of our flagship Digital Mission Engineering (DME) tools, DME Component Libraries allow developers and integrators to build applications that are:

- Platform independent (pure .NET or Java libraries)
- Thread safe and multithreaded
- Highly scalable
- Suitable for thick-client, thin-client, or server deployment

/ Open Architecture

DME Component Libraries provide an extensible, open architecture that allows customization virtually anywhere throughout the API. Extend existing capabilities with your own proprietary algorithms.

/ Foundational System Modeling Capabilities

The libraries offer numerous building blocks, which address some of the following major capabilities:

- Various temporal, translational, and rotational coordinate representations and transformation
- Low and high fidelity models for the Earth and other celestial bodies including support for interpolated terrain surface features
- Geometric primitives representing the kinematics of simple scalars, points, axes, and vectors with respect to different frames of reference
- Simple and advanced propagation algorithms for modeling the motion of land, air, sea, and space vehicles
- Computation of intervisibility (access) and coverage between assets while accounting for various constraints including sensor field of view
- Detailed communications, radar, and navigation system modeling and analysis
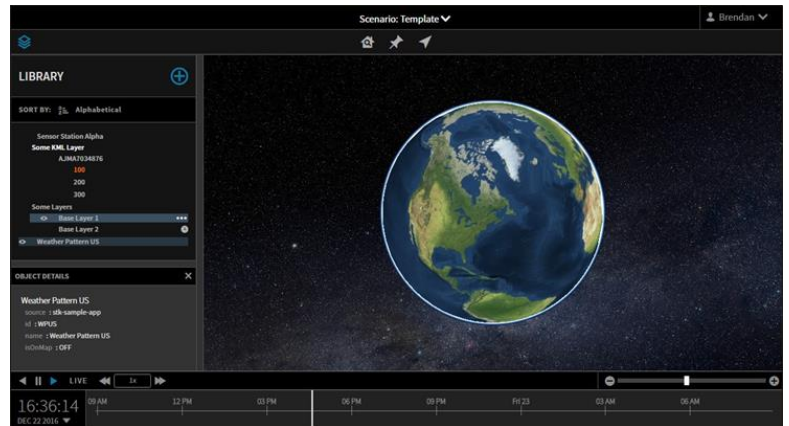
- 3D globe and 2D map visualization of time-dynamic objects and analysis results, either using a web browser (Cesium) or as a control in a desktop application (Insight3D)
- Dynamic data analysis for near real-time simulation including data archival and playback

/ Simulation and Analysis Libraries

Dynamic Geometry Library
This library provides basic architectural elements and algorithms for modeling time, position, and orientation for accurate vehicle propagation, sensor modeling, and intervisibility calculations. Functionality includes:

- Manipulation of scalars, points, axes, vectors, and reference frames
- Precise platform positioning and orientation
- High-fidelity, time-based intervisibility algorithm accounting for apparent motion, including light-time-delay and atmospheric refraction

Terrain Analysis Library
Employs a highly optimized terrain caching implementation to account for terrain when computing altitudes and performing intervisibility and coverage computations.

Spatial Analysis Library

Enables the computation of asset coverage over point sets, lines, regions, volumes, and dynamic platforms to measure effectiveness using:

- Flexible gridding algorithms
- Complex coverage definitions
- Extensible figures of merit

Communications Library

Provides computational elements for analyzing signal transmission between moving or stationary platforms with configurable signal processing and propagation models. Features include:

- Analog and digital radio frequency and digital optical signal types
- Transmitter, receiver, transceiver, and transponder devices
- various antenna gain pattern models, including Gaussian, parabolic, and custom patterns
- Amplifier, filter, mixer, modulator, and demodulator signal processors
- Support for signal characteristics including modulation, polarization, data rate, GPS PRN code, etc.
- Environmental models that account for signal attenuation and other effects based on ITU and other standard specifications
- Complex, multi-link communications system analysis, including jamming or interfering elements
- Link budget analysis between arbitrary nodes of the signal propagation graph

Employ the metrics produced by the Communications library as access constraints to determine intervisibility between objects. or use them with the Spatial Analysis library as figures of merit to determine coverage characteristics over a path, region, or set of points.

Radar Library

This library extends the capabilities of the Communications library to provide radar system performance analysis.

Along with the signal modeling functionality provided by the Communications library, the Radar library provides:

- Attitude dependent radar target cross section modeling
- Support for monostatic and bistatic radar systems
- Multiple target signal returns and intended target identification
- Metrics for dwell time, integrated signal-to-noise ratio, probability of detection, etc.

Like the Communications library, use the metrics available in the Radar library to determine intervisibility between objects or coverage characteristics.

TIREM library

Extends the capabilities of the Communications and Radar libraries with loss prediction over irregular terrain and seawater.

Navigation Accuracy Library

Model the GPS constellation using various data formats and configurable receivers to compute the navigational accuracy of terrestrial and spatial points. This library Includes algorithms for:

- Dilution of Precision (DoP)
- Navigational accuracy
- Receiver Autonomous Integrity Monitoring (RAIM)

You can also use the following to determine how communication links contribute to GPS errors:

- Multi-channel front-end model for GPS receivers
- Communications specific receiver noise model
- Carrier to Noise thresholds to determine tracking availability
- Signal jammers
- Models of all current operational GPS signals

Route Design Library

Generate trajectories and attitudes for aircraft, ground vehicles, and ships using vehiclespecific characteristics. Functionality includes:

- Pre-defined route procedures
- vehicle attitude modeling
- Terrain constrained procedures

Tracking library

Incorporate support for dynamically acquired data using the elements from this library. Integrate processing, visualization, and analysis for development of decision support, situational awareness, and distributed simulation applications using:

- optimized one-point analysis
- Data filtering and event processing
- Software transactional memory system
- Archiving and playback

Orbit Propagation Library

Provides industry-recognized force model algorithms for numerically propagating satellite orbit state and covariance through any orbit regime including LEO, MEO, GEO, HEO, and

interplanetary missions. Includes impulsive and finite maneuver modeling capabilities.

Segmented Propagation Library

Supplies architectural elements for computing vehicle trajectories where the manner of propagation changes with time. Capabilities allow:

- Performing numerical propagation with arbitrary stopping conditions.
- Solving for a trajectory by varying initial conditions and other propagation settings subject to arbitrary constraints on the motion and final conditions.

Aircraft Propagation Library

Propagate an aircraft through various maneuvers subject to flight phase performance models and wind effects. With defined aerodynamic and propulsion models, orientation of the aircraft can be determined assuming coordinated flight.

/ Visualization Libraries

DME Component Libraries contain powerful simulation and systems modeling capabilities which are further enhanced by a collection of visualization library options serving the needs of both desktop applications and web-first designs.

Cesium Library

Visualize time-dynamic objects and analysis on a 3D globe or 2D map natively in a web browser. This JavaScript visualization library enhances the open source Cesium project with the following proprietary features and rendering techniques:

- Complex sensor shapes and fields-of-view
- 3D time-varying vectors
- Fan geometry for rendering azimuth/ elevation masks and view-sheds

Produce CZML content for browser-based visualization (with Cesium) representing DME Components objects and analysis results. Build client/server applications connecting interactive time-dynamic 2D and 3D displays with web services that use the power of the other included analysis libraries.

Insight3D Visualization Library (Windows only)

Visualize time-dynamic objects and analysis with this embedded control in your custom desktop applications. Provides a high performance, accurate 3D globe, which renders a wide array of graphical primitives, custom terrain and imagery and offers flexible animation and camera controls.

/ Geospatial Content Server

Geospatial content Server (GcS) provides a comprehensive solution for hosting and serving high resolution terrain, imagery, and other heterogenous 3D data sets such as building data and complex 3D models. Geospatial content Server uses a web-first streaming mechanism designed for efficient delivery of massive geospatial data sets for visualization and analysis.

- Supports modern security protocols such as OAuth 2.0, OpenID connect, and SAML 2.0.
- Built-in identity management system.
- Integration with standard identity providers.
- Accessible from any standard browser.
- Interactive 3D assembly and exploration of geospatial content.
- Supports multiple terrain, imagery, and vector data formats.
- Supports 3D tiles —an open specification for streaming massive heterogeneous 3D geospatial datasets.

Distributable Architecture

- Supports scaling to meet enterprise needs.
- Supports more users as usage grows.

Terrain Processing

- Simplified level-of-detail pyramid.
- Client applications can precisely request terrain tiles when the data is not visually discernible.
- Adaptive level of detail; at the root zoom level, meshes are simplified until roughly 150km in error from original source data.
- Through use of an irregular mesh for terrain geometry, merging data sources of different resolutions does not require all geometry to be up sampled to the maximum resolution.

Terrain Hosting

- Uses open standards terrain runtime format, Quantized Mesh, to avoid vendor lock.
- Efficient storage on server through stand-alone database files processed from terrain tile sets.
- Removal of file system clutter by embedding tiles within a database rather than direct storage to the file system.
- Optimization of file management transfers between hosting nodes.
- Designed for processing on dedicated computers, yet easily imported into lightweight hosting nodes.

Prepopulated with Rich 3D Geospatial Content

Includes various-resolution global terrain data sets, 10-meter resolution global Sentinel-2 imagery, and 3D models in standard formats.

Terrain Data

Source	Coverage	Resolution
USGS GTOPO30	Entire Earth	1000 meters
CGIAR SRTM	60N -60S	90 meters
USGS National Elevation Dataset (NED)	United States	30 meters
USGS GTOPO30	Entire Earth	1000 meters
USGS CGIAR SRTM	60N - 60S	90 meters
USGS National Elevation Dataset (NED)	Continental U.S. and Alaska	10 meters
USGS National Elevation Dataset (NED)	North America	30 meters
USGS SRTM 1 arc sec	60N - 60S	30 meters
EU-DEM	Europe	30 meters

Imagery Data

Source	Coverage	Resolution
Sentinel-2 2019	56S – 84N	10 meters

"Pre-Processed" Formats

Format	3D model	Imagery	Terrain	Vector
3D Tiles	X			
Tile Map Service (TMS)		X		
Terrain Database			X	
CZML				X

Formats That Require Processing

Format	3D model	Imagery	Terrain	Vector
CityGML	X			
NITF		X		
GeoTIFF		X	X	
USGS ASCII DEM, CDED, DTED, HRE, FLT, HGT, BIL, BIP, BSQ			X	

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